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MILLING, BAKING, AND CHEMICAL EXPERIMENTS WITH HARD RED SPRING WHEAT 1954 CROP 2/

by

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1/ This is a progress report of cooperative investigations containing data, the interpretation of which may be modified with additional experimentation. Publication, display, or distribution of any data or any statements herein is prohibited without prior written approval of the Field Crops Research Branch, ARS, USDA, and the cooperating agency or agencies concerned.

2/ Cooperative investigations of the Field Crops Research Branch, Agricultural Research Service, and the Grain Division, Agricultural Marketing Service. The samples were obtained from the cooperative experiments with the State Agricultural Experiment Stations in the spring wheat region.

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INTRODUCTION

Samples of the standard varieties and many of the new strains of hard red spring wheats, grown in cooperative experiments in the spring wheat region of the United States 3/, are milled each year by the United States Department of Agriculture and the flours baked into bread to determine their quality characteristics.

The baking methods and techniques used on the 1954 crop were essentially the same as those used in similar work for the 1944 to 1953 crops, inclusive, and described in previous reports.

The purpose of this report is to make available to cooperators the quality data on standard varieties, new strains, and commercial hard red spring wheat from the 1954 crop.

SOURCE OF SAMPLES

Tests were made on composite and individual samples of the uniform varieties and of many other varieties and strains grown in plot experiments at cooperating stations. These included samples grown at Madison, Wis.; Crookston, Morris, Rosemont, and Southwest Minnesota; Newell, S. Dak.; Dickinson, Edgeley, Fargo, Langdon, and Minot, N. Dak.; and Havre, and Moccasin, Mont. Similar tests were made on composites of the 26 strains of wheat grown in the Uniform Regional Nurseries; on the wheats from the Supplementary Yield Nurseries; and on the wheats composited from the Station nurseries in Minnesota and Montana. Tests were also made on a number of sawfly resistant and foreign varieties and strains of wheat grown in Montana, and the better wheats from the Mexican breeding program grown in the United States.

There were also included 16 samples composited from samples of carlot receipts of wheat accumulated during a 90-day period of the 1954 crop movement by the Minneapolis, Duluth, Denver, and Great Falls offices of the Grain Division, Agricultural Marketing Service. These samples represent country-run receipts of the class Hard Red Spring Wheat and included only those lots that were graded No. 3 or better under the official grain standards of the United States. These hereafter are referred to as commercial samples. This is the sixteenth season that such samples have been collected and tested.

3/ Ausemus, E. R. Results of spring wheat varieties grown in cooperative plot and nursery experiments in the spring wheat region in 1954. U. S. Dept. Agr., Field Crops Res. Br. 366 CC. 66 pp. April 1955. University Farm, St. Paul 1, Minn. (Processed)

METHODS USED IN MILLING AND BAKING TESTS

After the removal of dockage, the samples were prepared for milling by use of a milling separator and a scourer (both of experimental or laboratory size). The wheat samples were tempered in two stages. The water for the first temper was added 72 hours prior to milling and raised the moisture content of the grain between 13.0 to 16.0 percent, depending upon the hardness of the variety, or within 1 percent of the total moisture required. The additional 1 percent of water for the second temper was added 1/2 hour before milling and raised the moisture content of the grain between 14.0 and 17.0 percent. The wheat was milled on a Buhler automatic laboratory flour mill provided with three break and three reduction rolls. Ten percent of the low grade flour was discarded, leaving a 90 percent patent flour which was used for the chemical and bread baking tests. However, the flour yield data in the tables are reported on the basis of a straight grade flour (100 percent) obtained from each sample.

The test weight per bushel of each sample was determined in the laboratory on the dockage-free wheat. The protein and ash contents are reported on a 14.0-percent-moisture basis and the flour yield on a moisture-free basis.

The hardness of the grain was determined by pearling 20 grams of dockage-free whole wheat for 1 minute in a model No. 38 Strong-Scott pearler. The amount of material pearled off, expressed as a percentage of the wheat, is called the pearling index. This index has been found useful, not only as a guide in tempering the samples for milling, but also as a measure of the hardness of the grain. A low index figure indicates hard grain and a high index figure indicates soft grain.

The bread baking tests on the 1954 samples were made by a rich formula with none or varying amounts of potassium bromate added.

This method with the various ingredients used in 1954 is shown in table 1.

Table 1. Baking method and ingredients used for samples of the 1954 crop.

Ingredients and treatment	Weight of ingredients, etc.
Flour (grams)	100.0
Yeast (grams)	2.0
Salt (grams)	1.5
Sugar (grams)	5.0
Potassium bromate 1/ (milligrams)	Optimum
Malted wheat flour (grams)	.25
Nonfat dry milk solids (grams)	4.0
Shortening (grams)	3.0
Water absorption (percent)	Optimum
Mixing time (minutes)	Optimum
Fermentation time (minutes)	180
Handling of dough	1st punch after 105 minutes 2nd punch after additional 50 minutes Mold after additional 25 minutes Proofing time - 55 minutes Baked 25 minutes at 450° F.

1/ Zero to 3 mgs. of potassium bromate used as necessary to obtain maximum loaf volume.

This baking procedure is based on the method of the American Association of Cereal Chemists with certain modifications deemed necessary for unbleached, experimentally milled flour.

A check or standard flour (12.8 percent protein and 0.50 percent ash on a 14.0-percent-moisture basis) was included in the baking trials with each day's tests. The average loaf volume of the baking tests made with the standard flour was 785 cc. and the standard error was 17.8 cc. On this basis the least significant difference between two single bakes is 50 cc.

The undesirable properties of each variety with respect to loaf volume, crumb grain, and color characteristics of the bread is indicated in the tables by "q" for questionable and "u" for unsatisfactory, adjacent to the numerical data pertaining to the property in question. No letter or other symbol with the numerical score is used to indicate a satisfactory rating. The following scores may be used as an index for judging the crumb grain and color and the quality of the bread:

59 or below	Very poor or unsatisfactory
60 to 69	Poor or questionable
70 to 79	Fair
80 to 89	Good
90 to 99	Very good
100 and above	Excellent

Bread loaf volume must also be adequate for the protein content of the flour if the variety is to be considered satisfactory. The loaf volumes are shown in the tables on an "as is" protein basis and, in addition, they are shown adjusted to a 12.0 percent flour protein content.

An unsatisfactory rating on one or more of the properties indicates that the variety or strain is generally undesirable for hard wheat milling or bread making purposes except that a questionable rating on one or more of the quality properties may be balanced by other outstanding properties. The milling properties are discussed in the text and should be considered along with the bread baking properties.

EXPERIMENTAL RESULTS

The quality results for the plot and nursery composites, individual station samples, and others are given in tables 2 to 7. The results for the commercial samples are shown in table 8. Summaries of the new strains of current interest compared with Lee are shown in table 9. These tables largely are self-explanatory. Acre yields are included, where comparable, to assist in the interpretation of results.

Station Plot Experiments

The quality data for the uniform varieties and others grown in plots are shown in table 2.

Wisconsin - Wisconsin samples were received only from Madison. All were relatively low in wheat protein content, a number being lower than 11.0 percent. A number of wheats were high enough in protein content to produce generally satisfactory bread, but none made exceptional bread like that from some of the other stations.

Many of the varieties and strains produced exceptionally high yields of flour, especially considering their test weight per bushel. Five of them had flour yields of 75.0 percent or better. Selkirk with only a test weight per bushel of 57.5 pounds produced an exceptionally high yield of 77.1 percent flour. All samples milled satisfactorily, with the exception of Sturgeon, which sieved or bolted slowly and was softer to the touch than the approved hard red spring wheats.

Selkirk, Mida, and Lee, of the varieties made the best bread. Among the strains, H195-45 was perhaps best, but H194-41 and H305-2 were nearly as good. The dough handling properties of all of these were good and the water absorption and mixing times satisfactory.

Minnesota - Samples were received from four Minnesota stations, Crookston, Southwest, Morris, and Rosemont. Protein contents of the wheat and flour were medium high at three of the stations. At Rosemont it was very high, with some samples 16.0 percent or better in wheat protein content.

A great many of the samples were low in test weight per bushel. The yield of flour was surprisingly good for many of these samples. Kentana appears to have made a good loaf of bread but milled poorly. It had a short dough mixing time. Lee x Mida sib. (M2868) produced satisfactory bread but the dough handling properties were sticky. The dough mixing time was short for the Rosemont sample. Frontana x Thatcher made a satisfactory loaf of bread but the dough mixing time was short and dough-handling properties poor. The milling properties of Frontana x K58-Newthatch (N No. 2867) were only fair. It made bread that was generally satisfactory.

Samples, Lee x Mida sib. (M2869), Selkirk, and Lee were perhaps the best of these in quality, considering the data as a whole.

South Dakota - South Dakota samples were received only from Newell.

The protein content of the samples was medium high, flour yields good for the test weight of the varieties and strains and internal bread characteristics generally good.

Spinkcota milled unsatisfactorily. The middlings were difficult to reduce to flour and the flour yield was lower than expected considering the test weight of the sample. It made good bread, but the water absorption was lower than Lee or Rushmore. The dough handling properties were not strong.

Selkirk, RL2563 x Lee (N.D. 1) and Lee x Mida sib.(N3880.127) have perhaps made the best bread of the strains from Newell, South Dakota. Selkirk is the strongest of these and is similar to the approved varieties in general quality characteristics.

Rushmore x Haynes Bluestem, Rushmore^{2} x Surpresa, Triunfo x Thatcher and Frontana x Thatcher have produced a loaf of bread of satisfactory characteristics. A number of these strains have made bread of excellent crumb color and/or grain texture. Rushmore x Haynes Bluestem was perhaps best of these samples in milling and produced a granular type flour. The other three handled much like a soft wheat. The flour from these was soft and velvety to the touch. The four strains all have short dough mixing times about 50 percent less than the approved hard red spring varieties. A short dough mixing time is generally associated with a short mixing tolerance, considered an undesirable property in a variety by the baker.

Willet, is a questionable wheat because of its unsatisfactory milling, dough handling, and mixing properties and will not be distributed for growing.

North Dakota - Samples were received from five North Dakota stations: Edgeley, Minot, Dickinson, Langdon, and Fargo.

Low test weights were in several cases associated with low flour yield and high ash, although noticeable exceptions are evident among the R.L. 2563 x Lee selections ND 1, 2, and 3. Short mixing time was typical for Willet, Frontana x Thatcher (Minn. 2854) and Lee x Mida sib. (3880.127). The average data for a number of the varieties and strains show that the loaf volume of some of the samples were lower than expected considering their protein contents.

Lee x Mida sib. (3880.127) is a stronger bread wheat than Frontana x Thatcher, (Minn. 2854). The dough-handling properties of Minn. 2854 were sticky, and weak, which with short dough-mixing time make it a questionable strain.

R.L. 2563 x Lee (ND 3) grown at the Fargo station appears to have been the best of the selections for bread from this cross. All three of these selections are promising.

It is of interest to note that the flour yield is high in these selections averaging better than the comparably grown Lee but about the same as Selkirk.

Montana - Samples were received from two Montana stations: Havre and Moccasin.

With the exception of Thatcher the samples from Moccasin made loaves lower in volume than expected considering the protein content of the samples. In general, the past performance of the varieties has been satisfactory. The wheat appeared to be sound, but the dough handling properties were poor and unsatisfactory. It is possible that the high temperatures (90° F. or higher) that prevailed some of the days during the fruiting period may account, in part, for the impaired loaf volumes.

The strains from Havre as a group made generally acceptable bread. Strain 1520 x 1752 (N2389) was best in flour yield. All milled satisfactorily. Perhaps the best strains, considering the data as a whole, were Pilot^2 x Thatcher (N2170) and Pilot^2 x Regent (N2183). Lee was strongest of the varieties and produced a loaf of bread having excellent internal properties.

Table 2 - Yield, milling, baking, and chemical results for hard red spring wheats grown in replicated "plots" in 1954.

Variety or Cross	C.I. No.	Acre Yield	Test Weight	Pearling Index Value	Protein		Flour		Absorption	Mixing Time	Optimum Baking Method				Loaf Volume Corrected to 12.0 Percent Protein
					Wheat	Flour	Yield	Ash			Bromate	Loaf Volume	Crumb Color	Crumb Grain	
		Bu.	Lb.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Min.	Mg.	Cc.	Score	Score	Cc.
Madison, Wisconsin															
Thatcher	10003	26.3	59.5	22.5	10.6	10.0	73.5	.52	60	2.50	1	654	65q	80	784
Willet	13099	24.3	58.9	32.1	12.0	11.0	75.0	.40	59	2.00	2	716	75	90	781
Rushmore	12273	27.1	60.6	25.3	11.0	10.3	73.7	.50	59	2.50	1	668	70	75	778
Lee	12488	26.5	60.0	28.6	11.8	10.7	75.2	.43	61	2.50	1	689	80	85	773
Mida	12008	23.4	60.0	26.5	11.2	10.3	74.7	.48	59	2.50	1	659	80	80	768
Selkirk	13100	28.8	57.5	27.5	11.3	10.6	77.1	.49	60	2.50	1	711	80	85	804
Henry	12265	26.6	60.0	32.8	10.1	8.9	72.6	.45	57	2.00	1	659	75	80	889
Sturgeon	11703	26.4	61.6	34.2	11.7	10.0	74.9	.46	59	1.75	1	702	85	85	842
Tha. x (Ill. 1-Wis. 38 x Hope), H194-41,W246	12649	31.4	60.0	27.6	10.8	9.5	74.9	.44	61	2.25	2	649	75	75	819
Tha. x (Ill. 1-Wis. 38 x Hope), H195-45,W242	12484	31.0	60.3	29.3	10.6	9.1	75.5	.44	58	2.50	1	643	80	80	847
Henry x Surpresa,H305-2		32.6	61.3	28.4	10.5	9.3	75.8	.47	58	2.00	1	677	75	80	874
Average		27.7	60.0	28.6	11.1	10.0	74.8	.46	59	2.27	1.9	675	76	81	810
Crookston, Minnesota															
Thatcher, M2303	10003	12.2	45.9	17.3	12.5	11.5	67.9	.47	61	2.25	1	782	60q	75	816
Mida, M2689	12008	13.0	50.0	21.0	12.9	12.0	70.6	.47	59	2.25	1	782	80	90	782
Henry, M2753	12265	21.2	50.0	26.7	14.1	13.0	68.5	.44	59	1.50	2	871	60q	80	804
Lee, M2776	12488	22.8	53.7	24.6	14.2	13.4	71.8	.42	59	2.50	1	821	85	85	735
Rushmore, M2803	12273	19.9	51.7	23.5	12.7	11.9	72.1	.43	59	2.50	1	776	65q	80	782
Frontana x Thatcher, M2854	13030	33.0	58.1	35.2	15.2	13.7	71.3	.37	59	1.25	2	839	90	100	735
Willet, M2855	13099	41.7	58.9	36.2	15.6	14.2	73.5	.37	59	1.00	2	868	85	95	734
Selkirk, M2859	13100	44.2	56.5	30.0	14.2	13.4	77.3	.43	59	2.00	2	848	80	90	759
Kentana, M2860	12263	32.6	58.8	40.1	13.9	12.4	72.1	.44	59	1.00	2	810	90	85	784
Front. x K58-Newthatch, M2867	13044	29.7	60.2	34.7	15.0	13.8	71.1	.40	59	2.00	2	858	90	90	746
Lee x Mida sib, Ns. 3880.127, M2868	13152	37.7	57.6	24.8	15.2	13.9	74.6	.46	61	1.25	3	810	95	80	699
Do. M2869	13043	33.6	58.4	25.4	14.4	13.2	73.7	.42	64	2.00	2	871	85	95	792
Average		28.5	55.0	28.3	14.2	13.0	72.0	.43	60	1.79	1.7	828	80	87	764

Table 2. Continued

Variety or Cross	C.I. No.	Acre Yield	Test Weight	Pearling Index Value	Protein		Flour		Absorption	Mixing Time	Optimum Baking Method				Loaf Volume Corrected to 12.0 Percent Protein
					Wheat	Flour	Yield	Ash			Bromate	Loaf Volume	Crumb Color	Crumb Grain	
		Bu.	Lb.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Min.	Mg.	Cc.	Score	Score	Cc.
Morris, Minnesota															
Mida	12008	9.4	50.1	24	11.2	10.1	67.6	.51	59	2.25	2	694	65q	75	824
Lee x Mida sib, Ns. 3880.227	13043	28.9	55.1	24	13.0	12.9	71.5	.46	61	2.25	1	797	80	90	741
Lee x Mida sib, Ns. 3880.127	13152	32.0	56.6	25	13.3	12.4	72.9	.49	62	1.75	2	785	85	85	760
Front. x K58-Newthatch, M2867	13044	22.5	59.6	37	12.4	12.1	71.0	.45	61	1.75	1	775	75	90	768
Kentana	12263	24.1	58.1	45	12.8	11.5	73.9	.47	60	1.50	3	773	95	90	806
Selkirk	13100	31.8	57.2	31	13.8	13.2	75.0	.48	63	2.25	2	847	80	90	769
Willet	13099	31.4	57.5	35	15.8	13.9	69.5	.41	60	1.25	1	850	85	90	733
Frontana x Thatcher, M2854	13030	22.9	58.8	34	15.0	14.0	70.5	.43	60	1.25	3	836	95	95	716
Rushmore	12273	17.9	53.2	27	12.2	11.5	73.4	.50	59	2.25	1	743	70	80	775
Lee	12488	22.2	54.0	28	12.5	11.5	72.8	.48	60	2.25	2	750	75	90	782
Henry	12265	24.9	50.1	26	11.9	11.0	69.7	.49	59	1.50	2	734	70	75	801
Thatcher	10003	11.6	50.1	22	11.4	10.2	64.4	.55	59	2.25	1	721	75	75	848
Average		23.3	55.0	30	12.9	12.0	71.0	.48	60	1.87	1.7	775	79	85	775
Rosemont, Minnesota															
Mida	12008	9.4	47.8	22	15.1	14.1	72.2	.60	61	2.00	2	953	85	95	811
Lee x Mida sib, Ns. 3880.227	13043	28.3	57.4	27	16.5	15.1	72.8	.48	58	2.25	2	881	90	85	700
Lee x Mida sib, Ns. 3880.127	13152	31.0	57.0	26	17.1	15.4	72.5	.48	61	1.25	3	876	100	85	683q
Front. x K58-Newthatch, M2867	13044	22.5	56.7	34	16.4	15.5	72.0	.51	62	1.75	2	1003	80	95	776
Kentana	12263	24.1	53.2	38	15.2	13.7	70.1	.54	59	1.00	3	841	85	90	737
Selkirk	13100	31.8	58.1	32	16.8	16.2	74.3	.50	61	2.00	2	1001	90	90	741
Willet	13099	31.4	55.7	33	17.0	15.8	70.6	.43	58	1.25	3	906	75	90	688q
Frontana x Thatcher, M2854	13030	22.9	53.5	30	16.7	15.7	70.1	.47	60	1.00	3	932	80	90	712
Rushmore	12273	17.9	51.9	24	14.1	13.4	73.0	.49	58	2.00	1	909	70	95	814
Lee	12488	22.2	54.3	27	16.5	15.7	70.7	.50	60	2.25	2	927	80	95	708
Henry	12265	24.9	50.9	28	15.3	14.7	72.5	.57	58	1.25	3	926	65q	80	756
Thatcher	10003	11.6	44.9	19	13.6	12.9	60.6	.54	61	1.75	3	918	65q	80	854
Average		23.2	53.0	28	15.9	14.9	70.9	.51	60	1.65	2.4	923	80	89	743

Table 2. Continued

Variety or Cross	C.I. No.	Acre Yield	Test Weight	Pearling Index Value	Protein		Flour		Absorption	Mixing Time	Optimum Baking Method				Loaf Volume Corrected to 12.0 Percent Protein
					Wheat	Flour	Yield	Ash			Bromate	Loaf Volume	Crumb Color	Crumb Grain	
		Bu.	Lb.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Min.	Mg.	Cc.	Score	Score	Cc.
Southwest, Minnesota															
Thatcher	10003	—	44.0	19.2	11.6	10.8	62.5	.56	59	2.75	1	752	60q	75	835
Mida	12008	—	43.8	21.0	11.5	10.6	64.7	.60	59	2.50	1	712	70	75	806
Henry	12265	—	48.7	28.2	14.4	13.0	67.6	.52	59	1.75	1	869	60q	85	802
Lee	12488	—	49.4	24.2	13.6	12.7	68.0	.47	59	2.75	1	825	85	90	779
Rushmore	12473	—	49.6	23.0	12.0	11.1	70.5	.51	59	2.25	1	726	70	75	785
Frontana x Thatcher, M2854	13030	—	54.4	38.8	16.0	14.8	67.8	.47	58	1.00	2	884	90	90	717
Willet	13099	—	54.2	41.3	15.5	14.6	69.5	.39	59	1.25	2	816	90	100	671q
Selkirk	13100	—	52.6	29.1	13.6	12.7	71.7	.47	59	2.00	1	791	90	90	747
Kentana	12263	—	55.0	45.9	13.5	12.1	70.0	.46	59	1.50	1	743	80	80	737
Average			50.2	30.1	13.5	12.5	68.0	.49	59	1.97	1.2	791	77	84	759
Average Data for Nine Varieties and Strains from Four Minnesota Stations 1/															
Frontana x Thatcher, M2854	13030	26.3	56.2	35	15.7	14.6	69.9	.44	59	1.13	2.5	873	89	94	718
Selkirk	13100	35.9	54.9	31	14.6	13.9	74.6	.47	61	2.06	1.8	872	85	90	753
Willet	13099	34.8	56.6	36	16.0	14.6	70.8	.40	59	1.19	2.0	860	84	94	706
Henry	12265	23.7	49.9	27	13.9	12.9	69.6	.51	59	1.50	2.0	850	64q	80	791
Lee	12488	22.4	52.9	26	14.2	13.3	70.8	.47	60	2.44	1.5	831	81	90	750
Thatcher	10003	11.8	46.2	19	12.3	11.4	63.9	.53	60	2.25	1.5	793	65q	76	834
Kentana, M2860	12263	26.9	56.3	42	13.9	12.4	71.6	.48	59	1.25	2.3	792	88	89	766
Rushmore	11708	18.6	51.6	24	12.8	12.0	72.3	.48	59	2.25	1.0	790	69q	83	790
Mida	12008	10.6	47.9	22	12.7	11.7	68.8	.55	60	2.25	1.5	785	75	84	806

1/ Crookston, Morris, Rosemont, and Southwest Stations.

Table 2. Continued

Variety or Cross	C.I. No.	Acre Yield	Test Weight	Pearling Index Value	Protein		Flour		Absorption	Mixing Time	Optimum Baking Method				Loaf Volume Corrected to 12.0 Percent Protein
					Wheat	Flour	Yield	Ash			Bromate	Loaf Volume	Crumb Color	Crumb Grain	
		Bu.	Lb.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Min.	Mg.	Cc.	Score	Score	Co.
Newell, South Dakota															
Lee	12488	24.6	56.2	21.8	13.1	12.2	72.5	.47	60	2.25	1	715	80	90	703
Rushmore	12273	17.5	52.4	21.0	12.8	12.2	70.1	.51	59	1.75	2	716	70	80	698
Willet	13099	27.4	58.0	33.3	14.5	13.9	67.9	.40	58	1.00	2	816	80	90	704
Selkirk	13100	28.9	54.1	29.8	13.1	12.6	71.1	.45	59	2.00	3	779	75	85	741
Spinkcota	12375	24.6	59.4	34.7	13.5	12.6	67.5	.41	56	1.75	1	806	75	90	767
Rushmore^2 x Haynes Bluestem	13162	30.6	59.2	27.5	14.4	13.9	71.5	.46	58	1.00	1	824	90	100	711
Rushmore^2 x Surpresa	12972	29.9	59.3	36.3	13.1	11.7	69.3	.40	58	0.75	1	705	75	90	724
Triunfo x Thatcher, S.D. 630	12625	33.6	61.6	37.5	14.0	12.4	71.2	.42	58	1.00	1	803	90	90	778
Frontana x Thatcher, M2854	13030	30.6	58.9	32.0	14.2	13.9	71.0	.44	58	1.00	2	818	100	95	707
R.L. 2563 x Lee, ND1	13157	26.7	58.2	25.4	13.9	13.5	71.6	.47	58	1.75	0	776	95	95	690
Lee x Mida sib., 3880.127	13152	28.7	58.8	23.3	13.5	12.8	72.3	.45	58	1.25	1	737	80	85	690
Average		27.5	57.8	29.3	13.6	12.8	70.5	.44	58	1.23	1.4	772	87	90	724
Dickinson, North Dakota															
Thatcher	10003	9.9	50.6	24.4	16.3	15.2	68.2	.39	57	2.25	1	838	90	90	682q
Lee	12488	11.0	54.4	28.3	16.6	15.4	70.6	.42	57	2.00	1	853	95	95	665q
Mida	12008	10.5	55.3	25.5	15.5	14.7	73.7	.42	58	2.25	2	804	95	95	657q
Willet	13099	11.2	53.3	31.0	17.3	16.2	68.9	.42	59	1.25	2	880	80	90	651q
Selkirk	13100	12.7	51.4	27.9	16.3	15.3	73.6	.42	59	2.25	2	979	95	100	767
Frontana x Thatcher, Minn. N2854	13030	11.3	53.8	31.9	17.4	16.3	68.8	.41	59	1.25	1	825	70	70	607u
Lee x Mida sib.,3880.127	13152	12.4	55.8	26.6	16.0	14.8	70.7	.45	62	1.50	2	828	80	80	671q
Average		11.3	53.5	27.9	16.5	15.4	70.6	.42	59	1.82	1.6	858	86	89	669q

Table 2. Continued

Variety or Cross	C.I. No.	Acre Yield	Test Weight	Pearling Index Value	Protein		Flour		Absorption	Mixing Time	Optimum Baking Method				Loaf Volume Corrected to 12.0 Percent Protein
					Wheat	Flour	Yield	Ash			Bromate	Loaf Volume	Crumb Color	Crumb Grain	
		Bu.	Lb.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Min.	Mg.	Cc.	Score	Score	Cc.
Edgeley, North Dakota															
Lee	12488	17.8	54.4	26.4	16.2	15.1	70.2	.44	59	2.00	1	858	85	85	682q
Mida	12008	12.0	51.9	21.7	14.4	13.2	69.4	.44	59	2.25	1	822	80	80	747
Willet	13099	27.0	54.7	27.8	18.3	16.9	67.3	.47	59	1.25	1	770	75	70	547u
Rushmore	12273	15.2	55.6	25.8	14.8	13.9	74.4	.44	59	1.75	0	833	80	85	719
Selkirk	13100	24.3	53.1	28.8	16.7	15.8	72.9	.46	59	2.25	2	918	85	100	697
Frontana x Thatcher, M2854	13030	26.2	53.2	28.0	17.6	17.0	68.2	.50	61	1.50	3	942	80	85	665q
Lee x Mida sib., 3880.127	13152	22.5	55.0	24.1	16.7	15.5	72.3	.49	61	1.50	3	894	90	85	692
Average		20.7	54.0	26.1	16.4	15.3	70.7	.46	60	1.79	1.6	862	82	84	676
Fargo, North Dakota															
Mida	12008	14.5	50.9	20.7	11.0	10.0	66.5	.55	58	2.25	1	616	70	70	739
Rushmore	12273	23.5	55.9	22.8	12.7	11.4	72.1	.53	59	2.50	1	608	75	75	640u
Lee	12488	28.7	58.0	24.6	12.4	11.4	73.0	.51	64	2.75	1	690	80	80	726
Thatcher	10003	16.6	52.7	18.8	11.7	10.9	68.8	.58	62	2.25	1	653	70	80	718
Selkirk	13100	38.4	57.8	27.8	15.1	14.2	75.0	.51	60	2.50	1	712	85	80	601u
Willet	13099	28.5	59.0	33.4	15.3	13.8	70.9	.49	61	1.50	2	801	85	85	697
Frontana x Thatcher, M2854	13030	33.0	59.7	31.8	15.1	13.9	73.6	.54	62	1.50	2	791	90	90	683q
Lee x Mida sib., Ns 3880.127	13152	34.5	59.7	25.2	13.7	12.3	74.0	.52	60	2.00	1	685	90	80	669q
R.L. 2563 x Lee, ND1	13157	31.1	60.0	28.5	14.5	13.2	75.5	.50	61	2.50	1	715	90	85	650q
R.L. 2563 x Lee, ND2	13158	31.8	60.2	26.8	14.7	13.7	74.6	.61	64	2.50	1	748	85	90	653q
R.L. 2563 x Lee, ND3	13159	30.9	60.0	26.7	14.5	13.4	75.5	.63	65	2.75	1	788	90	95	705
Average		28.3	57.6	26.1	13.7	12.7	72.7	.54	61	2.27	1.2	710	83	83	670q

Table 2. Continued

Variety or Cross	C.I. No.	Acre Yield	Test Weight	Pearling Index Value	Protein		Flour		Absorption	Mixing Time	Optimum Baking Method				Loaf Volume Corrected to 12.0 Percent Protein
					Wheat	Flour	Yield	Ash			Bromate	Loaf Volume	Crumb Color	Crumb Grain	
		Bu.	Lb.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Min.	Mg.	Cc.	Score	Score	Cc.
Langdon, North Dakota															
Lee	12488	28.5	56.5	24.9	14.2	13.1	69.7	.39	62	2.50	1	766	85	90	702
Willet	13099	45.3	60.5	33.6	15.5	14.7	73.2	.38	64	1.25	3	874	90	80	713
Rushmore	12273	27.2	57.0	22.4	12.0	11.7	74.6	.40	60	2.25	1	726	70	75	745
Selkirk	13100	44.7	59.3	28.9	14.2	13.3	75.8	.40	62	2.00	3	905	80	75	816
Frontana x Thatcher,M2854	13030	45.7	61.0	30.5	14.9	13.9	72.4	.41	62	1.25	2	768	80	80	663q
Lee x Mida sib.,3880.127	13152	33.7	59.1	24.7	14.7	13.5	73.0	.41	61	1.50	3	729	80	80	648q
Average		37.5	58.9	27.5	14.3	13.4	73.1	.40	62	1.79	2.2	795	81	80	712
Minot, North Dakota															
Lee	12488	16.3	54.6	25.5	13.3	12.4	72.6	.44	60	2.25	2	726	85	80	703
Mida	12008	10.6	53.3	22.0	11.8	10.8	69.3	.44	58	2.00	1	686	70	75	762
Willet	13099	30.9	58.8	35.1	15.3	14.3	70.9	.36	61	1.50	2	779	85	85	653q
Selkirk	13100	26.4	57.6	29.6	13.9	13.0	76.9	.40	58	2.00	2	791	90	90	730
Frontana x Thatcher, Minn. N2854	13030	33.2	59.8	35.0	15.2	14.4	69.8	.40	61	1.00	3	858	95	95	715
Lee x Mida sib.,3880.127	13152	29.2	58.5	26.3	14.5	13.4	72.5	.38	60	1.50	3	727	90	90	651q
Average		24.4	57.1	28.9	14.0	13.1	72.0	.40	60	1.71	2.2	761	86	86	698
Average Data for Five Varieties and Strains From Five North Dakota Stations 1/															
Selkirk	13100	29.3	55.8	29	15.2	14.3	74.8	.44	60	2.20	2.0	861	87	89	722
Frontana x Thatcher, M2854	13030	29.9	57.5	31	16.0	15.1	70.6	.45	61	1.30	2.2	837	83	84	666q
Willet	13099	28.6	57.3	32	16.3	15.2	70.2	.42	61	1.35	2.0	821	83	82	648q
Lee	12488	20.5	55.6	26	14.5	13.5	71.2	.44	60	2.30	1.2	779	86	86	692
Lee x Mida sib.,3880.127	13152	26.5	57.6	25	15.1	13.9	72.5	.45	61	1.60	2.4	773	86	83	667q

1/ Dickinson, Edgeley, Fargo, Langdon, and Minot Stations.

Table 2. Continued

Variety or Cross	C.I. No.	Acre Yield	Test Weight	Pearling Index Value	Protein		Flour		Absorption	Mixing Time	Optimum Baking Method				Loaf Volume Corrected to 12.0 Percent Protein
					Wheat	Flour	Yield	Ash			Bromate	Loaf Volume	Crumb Color	Crumb Grain	
		Bu.	Lb.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Min.	Mg.	Cc.	Score	Score	Cc.
Havre, Montana															
Lee	12488	26.4	58.0	38.9	16.4	15.1	71.3	.40	59	2.00	2	869	100	95	690
Willet	13099	24.1	56.5	39.9	17.3	16.2	69.4	.47	60	1.50	2	765	75	80	566u
Selkirk	13100	25.4	55.5	33.2	15.4	14.6	74.0	.42	61	2.25	2	835	90	90	687
Thatcher	10003	26.7	56.6	34.8	16.1	15.1	74.1	.43	61	2.25	1	897	85	90	712
Pilot[2] x Thatcher, N2170	12974	28.6	58.1	31.4	15.7	14.6	75.1	.46	61	1.75	1	918	95	90	754
1520 x 1752, N2389	13041	33.1	60.7	33.8	14.7	13.8	76.3	.42	60	1.75	2	782	80	85	680
Pilot[2] x Merit, N2164	—	28.8	58.0	25.9	15.1	14.0	72.5	.45	61	2.00	2	818	75	80	701
Pilot[2] x Regent, N2183	13042	29.9	56.8	38.4	14.9	13.9	72.8	.41	60	2.00	1	876	80	90	756
1750 x 1753	12975	29.3	59.0	32.7	14.1	13.2	74.7	.44	59	2.25	1	782	90	90	711
Average		28.0	57.7	34.3	15.5	14.5	73.3	.43	60	1.97	1.6	838	86	88	693
Moccasin, Montana															
Lee	12488	11.0	56.8	33.1	15.7	14.9	74.7	.44	63	2.50	1	756	80	85	608q
Willet	13099	10.9	53.0	33.9	17.8	16.9	67.1	.46	61	1.50	2	732	70	75	519u
Selkirk	13100	9.8	52.0	28.8	15.7	14.9	71.6	.44	63	2.25	3	823	65q	80	662q
Thatcher	10003	11.2	54.5	27.6	14.9	13.8	71.1	.47	61	2.25	2	809	75	90	704
Average		10.7	54.1	30.8	16.0	15.1	66.1	.45	62	2.13	2	780	73	83	620
Average Data for Four Varieties From Two Montana Stations 1/															
Thatcher	10003	19.0	55.6	31	15.5	14.5	72.6	.45	61	2.25	1.5	850	80	90	703
Selkirk	13100	17.6	53.8	31	15.6	14.8	72.8	.43	62	2.25	2.5	829	78	85	672q
Lee	12488	18.7	57.4	36	16.1	15.0	73.0	.42	61	2.25	1.5	813	90	90	650q
Willet	13099	17.5	54.8	37	17.6	16.6	68.3	.47	61	1.50	2.0	749	73	78	541u

1/ Havre and Moccasin Stations.

Uniform Regional Nursery Composite

Twenty-six varieties of wheat from the Uniform Regional Nursery have been tested for their milling, baking, and chemical properties. A composite of the grain was made from 10 stations as shown in a footnote to table 3 with the following results.

A number of the samples milled unsatisfactorily. The bran was generally tough and hard to clean free from the flour or the middlings reduced slowly as mentioned later. In some samples the flour was difficult to bolt or sieve.

The best strains for bread, considering the data as a whole, were: RL 2563 x Lee (ND 1 and ND 2), Lee x Mida sib. (Ns.3880.164, .191 and .227), 1520 x 1732 and Pilot[2] x Regent (N 2183). These strains have many of the properties of Marquis, Thatcher, Selkirk, and Lee. The loaf volumes of the strains were reasonably good, compared on a 12.0 percent flour protein basis, and the internal bread characteristics good.

ND 1 and ND 2 have made satisfactory bread in past tests. The seven strains appeared to have no objectionable or poor properties. All milled satisfactorily, produced doughs of good handling properties, and had dough-mixing times similar to that of the approved varieties.

Rushmore x Haynes Bluestem (SD1935) was satisfactory except for dough-mixing time which was shorter than the approved varieties.

The strains with Frontana as one of the parents all had generally short dough-mixing times and questionable milling properties. A considerable number of these strains made bread of very satisfactory internal characteristics. It is of interest to note that the bromate requirements were high, indicating the need of an oxidizating agent for best results. The pearling index values were high for many of the Frontana strains, indicating that they are softer in kernel texture than the approved varieties.

Kenya-Gular-Pilot x K58-Newthatch made reasonably good bread, but was deficient in dough-mixing time, milling, and dough-handling properties. It was better than last year, when it was found to yield a low percentage of flour in addition to being deficient in a number of other quality properties. The performance of this strain is not very promising.

Table 3. Milling, baking, and chemical results on 26 wheats grown in the Uniform Regional Nursery, 1954 crop 1/

Variety or Cross	C.I. No.	Acre Yield	Test Weight	Pearling Index Value	Protein		Flour		Absorption	Mixing Time	Optimum Baking Method				Loaf Volume Corrected to 12.0 Percent Protein
					Wheat	Flour	Yield	Ash			Bromate	Loaf Volume	Crumb Color	Crumb Grain	
		Bu.	Lb.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Min.	Mg.	Cc.	Score	Score	Cc.
Marquis	3641	12.8	55.2	32	15.2	13.9	69.0	.48	62	2.25	2	954	85	100	824
Thatcher	10003	14.6	55.0	32	15.5	14.3	70.4	.47	61	2.00	1	945	80	85	793
Selkirk	13100	28.3	55.0	34	15.5	14.5	73.5	.44	61	2.00	2	932	80	95	771
R.L. 2563 x Lee, ND1	13157	26.8	56.6	34	15.5	14.5	73.9	.43	61	2.25	1	940	90	100	778
R.L. 2563 x Lee, ND2	13158	25.1	57.3	30	16.6	15.6	69.9	.48	61	2.25	1	951	80	95	731
R.L. 2563 x Lee, ND3	13159	27.8	57.5	30	16.6	15.5	71.4	.50	62	1.75	2	887	80	90	686q
Lee x Mida sib., 3880.127	13152	26.5	58.6	31	15.7	14.4	71.5	.46	62	2.00	2	880	90	90	733
Lee x Mida, Ns. 3880.164	13040	27.4	58.4	34	15.9	14.5	70.2	.45	63	2.00	2	887	90	95	734
Lee x Mida, Ns. 3880.191	13153	25.8	59.1	30	15.3	14.0	70.0	.43	62	2.00	1	832	80	85	713
Lee x Mida, sib., Ns.3880.227	13043	25.9	57.3	30	15.9	14.5	71.9	.45	59	2.25	2	855	85	100	708
1520 x 1752, N2389	13041	14.2	55.5	28	14.4	13.1	70.7	.46	62	2.00	1	810	80	85	742
Pilot[2] x Regent, N2183	13042	17.0	55.6	30	14.6	13.4	71.3	.43	59	2.00	2	912	80	90	817
Frontana x II-44-29, II-50-35	13044	24.5	58.3	36	15.2	14.0	66.1	.43	61	2.00	2	974	80	100	835
Willet	13099	31.0	57.0	37	16.8	16.0	71.2	.41	62	1.25	2	963	80	90	722
Frontana x Thatcher, II-46-13	13030	30.7	57.2	36	16.4	15.8	71.3	.39	62	1.00	2	956	80	100	727
Rushmore x Haynes Bluestem, SD 1935	13162	26.8	58.0	34	15.9	15.0	73.2	.39	64	1.25	2	990	90	95	792
Rushmore x Haynes Bluestem, SD 1931	13049	26.1	59.4	30	15.5	14.8	68.8	.43	64	1.50	1	961	100	95	780
Kenya-Gular-Pilot x K58 Newthatch, II-44-52	13050	25.1	55.8	38	16.0	15.0	69.8	.45	61	1.25	2	1034	80	90	828
Do II-44-58	13200	27.4	57.5	26	15.0	14.2	66.8	.59	64	1.50	2	847	80	80	716
Lee x Frontana, II-47-10	13201	28.9	58.5	39	15.6	14.6	66.3	.45	59	1.25	3	905	85	85	743
Frontana x II-44-22, II-50-8	13202	27.8	57.6	44	16.7	15.5	68.5	.46	62	1.25	2	911	65q	90	705
Frontana x II-44-29, II-50-17	13154	28.1	58.5	36	16.1	15.6	71.7	.48	62	1.25	2	921	80	95	709
Frontana x II-44-29, II-50-25	13155	29.5	59.2	41	16.1	14.5	70.9	.42	61	1.25	3	886	90	95	733
Frontana x II-44-29, II-50-32	13203	27.1	60.0	37	15.2	13.4	70.4	.37	60	1.25	2	825	90	90	738
Frontana x II-44-29,	13156	24.4	58.6	39	15.4	13.9	66.4	.38	61	1.50	2	887	90	100	765
Lee	12488	22.8	56.1	34	15.7	14.5	71.6	.42	62	2.25	2	896	95	95	742
Average			57.8	34	15.7	14.6	70.3	.44	61.5	1.71	1.8	913	84	93	625

1/ Composite of Havre, Moccasin, Madison, Langdon, Fargo, Minot, Morris, Crookston, St. Paul, and Waseca Stations.

Supplementary Hard Red Spring Regional Yield Nursery

Twenty-one strains including the standard varieties, Lee, Selkirk, and Willet from the Supplementary Hard Red Spring Regional Yield Nursery were tested for milling, baking, and chemical properties. A composite of grain from five stations was made as indicated in a footnote in table 4.

The protein contents of the wheats were generally high, which may account, in part, for the rather satisfactory bread they made. Many of the strains produced a high yield of flour considering the test weight of the samples. All of the varieties and strains appeared to have made satisfactory bread with some samples better in this respect than others. The pearling index values showed that a number of the strains were soft in texture. These produced flours that were soft to the touch and resembled the soft red winter wheats in this respect. On these samples the pearling index values were generally higher than 39 percent. These may be softer than the millers of hard red spring wheat would like.

The best strains and varieties for bread considering the data as a whole were Thatcher x K338AC (ND 4 and 18) and NS4021 x K338AC (ND 21). These scored high in internal bread characteristics and had good loaf volumes. Samples Thatcher x K338AC (ND 5 and 9) also made good bread, but their milling properties were only fair. The middlings were difficult to reduce and the flour sieved slowly.

Those samples that were next best (slightly lower in internal bread properties than the first group) were Rushmore x K338AC (ND 27) and Thatcher x K338AC (ND 1 and ND 33), Lee, Selkirk, and Lee x Mida sib. (Ns.3880.70). These samples had satisfactory milling and dough handling properties.

Three strains produced lower than expected loaf volumes corrected to a 12.0 percent flour protein basis. These were NS 4021 x K338AC (ND 23), Lee x Mida sib. (Ns.3880.133) and Frontana x II-44-29 (NS II-50-65). This last named strain milled only fair, the flour being soft and sieved slowly.

NS 4021 x K338AC (ND 25), Rushmore x K338AC (ND 11), and Thatcher x K338AC (ND 5) produced bread loaf volumes of 1,000 cc. or higher. These were also high in protein content, exceeding 17.0 percent in the wheat. The milling properties of ND 25 were only fair as were those of Frontana x II-44-29 (NS II-50-65 and -72).

Table 4. Milling, baking, and chemical results on hard red spring wheats grown in the Supplementary Regional Yield Nursery, 1954 crop 1/

Variety or Cross	C.I. No.	Test Weight	Pearling Index Value	Protein		Flour		Absorption	Mixing Time	Optimum Baking Method				Loaf Volume Corrected to 12.0 Percent Protein
				Wheat	Flour	Yield	Ash			Bromate	Loaf Volume	Crumb Color	Crumb Grain	
		Lb.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Min.	Mg.	Cc.	Score	Score	Cc.
Thatcher x K338AC, ND 4		56.3	40	16.7	15.7	73.7	.49	59	2.00	2	955	90	100	730
Thatcher x K338AC, ND 5		56.3	42	17.9	16.7	71.1	.53	59	2.00	2	1009	90	100	725
Thatcher x K338AC, ND 9		58.1	42	16.9	16.0	68.4	.49	56	2.00	2	998	90	100	748
Rushmore x K338AC, ND 11		60.4	46	17.7	16.8	74.3	.56	56	2.00	3	1040	75	90	743
Thatcher x K338AC, ND 18		56.5	37	16.1	15.3	73.5	.46	56	2.00	2	973	90	100	763
N.S. 4021 x K338AC, ND 21		58.8	31	17.4	16.2	70.7	.52	57	2.00	2	988	95	100	732
Do. ND 23		57.7	43	17.1	16.4	72.5	.49	57	1.75	3	937	90	100	686q
Do. ND 25		56.8	39	17.8	16.9	69.9	.55	59	2.00	2	1002	85	95	711
Rushmore x K338AC, ND 27		58.0	33	15.0	14.4	74.8	.48	60	2.00	2	848	85	90	707
Thatcher x K338AC, ND 33		60.0	39	16.7	15.2	72.8	.43	57	1.75	2	887	85	90	700
Lee x Mida sib., Ns. 3880.27		54.2	27	14.6	13.6	71.6	.47	60	1.75	2	831	80	90	717
Do. Ns. 3880.29		56.5	26	14.9	14.1	71.4	.45	60	1.75	2	855	85	85	728
Do. Ns. 3880.70		55.9	25	14.6	13.3	70.9	.45	57	1.75	2	813	95	95	733
Do. Ns. 3880.133		55.2	27	14.8	13.7	71.4	.47	60	1.75	2	779	85	85	682q
Do. Ns. 3880.141		56.3	28	14.9	14.0	70.5	.44	61	1.75	2	837	90	85	717
Frontana x II-44-29, Ns. II-50-65		60.1	34	16.5	15.6	68.6	.51	59	1.50	2	858	90	95	660q
Do. Ns. II-50-72		59.0	41	15.4	14.9	70.1	.54	58	2.25	2	940	95	95	757
R.L. 2565 x Lee 1578, ND 1		55.6	31	15.6	15.0	74.3	.50	62	2.50	2	946	90	90	757
Lee	12488	52.7	27	14.4	13.9	72.9	.54	60	2.25	2	874	85	90	754
Selkirk, CT 186	13100	51.5	33	16.4	16.0	74.6	.55	57	1.75	2	948	95	95	711
Willet	13099	55.6	36	15.7	15.5	72.8	.49	60	1.50	2	984	95	95	762
Average		56.7	35	16.1	15.2	71.9	.50	59	1.90	2.1	924	89	94	729

1/ St. Paul, Crookston, Morris, Fargo, and Edgeley Stations.

State Nursery Trials

Results for the composite samples grown in the Minnesota Uniform Yield Nursery and in the Montana Advanced Yield Nursery are shown in table 5. A composite of the grain from a number of stations was made as indicated in a footnote to table 5.

Minnesota Uniform Yield Nursery

The protein contents of the wheat samples were generally high, with 14 of them testing 15.0 percent or higher in wheat protein content. The loaf volumes for many of the strains were not as high as expected when corrected to a 12.0 percent flour protein content, and when compared on the same basis with the loaf volumes for Thatcher, Mida, or Marquis. A number of the strains produced high yields of flour considering the test weight of the samples. Many of these samples for the most part had low test weights of around 50 pounds. These better flour yielding samples were Thatcher, Mida, 1520 x 1752 (M2824), Pilot^2 x Regent (NN2183), and Kentana x Yaqui (III-53-5). A number of other varieties and strains, but higher in test weight per bushel, also showed good flour yields. These were Lee, Lee x Mida Sib. (Ns.3880.164), Rushmore x Haynes Bluestem, and Lee x Frontana (II-50-32). All these varieties and strains had satisfactory milling properties. Strain R.L. 2563 x Lee (ND 3), produced an exceptionally high yield of flour, but the milling properties of the wheat were poor.

The pearling index values showed that a number of the strains were soft in texture. These produced flours that were soft to the touch and resembled the soft red winter wheats in this respect. On these samples the pearling index values were generally higher than 39 percent. These higher pearling index samples were Frontana x K58-Newthatch (M2867), Frontana x II-44-29 (N Nos. II-50-29, II-50-69, II-50-72, II-50-75, II-50-17, and II-50-25), Lee x Frontana (II-50-8), Frontana x II-44-22 (N No. II-50-14), and Spinkcota. Yaqui-Egyptian-Timstein, was highest of the group in pearling index value (53 percent) and produced an extremely soft flour to the touch. These wheats may possibly be softer than the millers of hard red spring wheats would like. It is of interest to note that the strains generally made with Frontana as one of the parents, are softer in texture according to the pearling index test and produced a softer type flour than that from the approved hard red spring wheats, Thatcher, Mida, and Lee.

A few of the strains had questionable milling qualities. The middlings from the R.L. 2563 x Lee (ND 1, 2, and 3) strains were difficult to reduce to flour and sieved or bolted slowly. The other unsatisfactory milling samples which were generally the Frontana strains produced soft type flours that were difficult to grind and sieved slowly.

The other questionable milling samples were Kenya-Gular-Pilot x K58 Newthatch, Frontana x II-44-22 (N Nos. II-50-14, II-50-37, II-50-41), and Frontana x II-44-29 (N No. II-50-65). All the remaining strains in this group had satisfactory milling properties.

The best strains and varieties for bread considering the data as a whole, were Thatcher, Mida, 1520 x 1752 (M2824), Pilot^2 x Regent (NN2183), Rushmore x Haynes Bluestem, Lee x Mida sib. (Ns.3880.191), Frontana x II-44-29 (N Nos. II-50-17, II-50-34, II-50-72, and II-50-75), and Kentana x Yaqui. The internal bread characteristics of these were satisfactory. Their loaf volumes corrected to a 12.0 percent flour protein basis were higher than 800 cc's. A number of these had bread grain and texture scores of 100 and were better than the approved varieties comparably tested.

A number of other strains that made good bread, but averaged lower in loaf volume (on a 12.0 percent basis) than above were Selkirk, Lee x Mida sib. (Ns. 3880.127 and .164), Frontana x K58 Newthatch (M2867), Rushmore x Haynes Bluestem, Lee x Frontana (II-50-32), Frontana x II-44-22 (II-50-53), Yaqui-Egyptian-Timstein, and Frontana x II-44-29 (II-50-69).

The other samples from the uniform nursery were deficient in one or more milling or baking properties and because of this are not as promising for bread as those samples listed. It is possible that in another year some may not show these deficiencies which will make them more promising than at present for bread.

Table 5. Milling, baking, and chemical results on hard red spring wheats grown in the Minnesota Uniform Yield Nursery, 1954 crop 1/

Variety or Cross	C.I. No.	Test Weight	Pearling Index Value	Protein		Flour		Absorption	Mixing Time	Optimum Baking Method				Loaf Volume Corrected to 12.0 Percent Protein
				Wheat	Flour	Yield	Ash			Bromate	Loaf Volume	Crumb Color	Crumb Grain	
		Lb.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Min.	Mg.	Cc.	Score	Score	Cc.
Lee	12488	55.7	30	14.3	13.8	75.0	.55	59	2.00	1	822	95	85	715
Thatcher	10003	47.6	24	13.3	12.6	71.4	.57	60	2.25	1	915	80	95	871
Mida	12008	50.8	27	13.0	12.4	74.3	.49	59	2.00	1	840	80	85	813
Marquis	3641	50.0	27	13.3	12.5	67.0	.59	57	1.75	1	830	85	90	797
Frontana x Thatcher, M 2854	13030	59.0	38	16.0	14.8	73.4	.50	60	1.00	2	855	80	90	693
Lee x Mida sib., Ns. 3880.164	13040	58.7	31	15.1	14.0	75.5	.53	62	2.00	2	837	90	95	717
1520 x 1752, M 2824	13041	49.0	23	12.1	11.7	72.0	.57	59	2.00	1	801	75	80	822
Pilot x Regent, NN 2183	13042	51.7	26	13.2	12.2	72.0	.55	58	1.75	2	869	75	85	855
Mida x Lee sib., Ns. 3880.227	13043	57.5	28	14.5	13.3	73.4	.56	58	2.00	2	847	90	90	764
Frontana x K 58-Newthatch, M 2867	13044	59.7	40	15.0	13.9	70.7	.51	59	2.00	2	877	90	95	757
Rushmore x Haynes Bluestem	13049	59.5	32	14.1	13.9	71.7	.53	62	1.50	1	951	85	100	821
Kenya-Gular-Pilot x K 58-Newthatch	13050	55.8	38	15.4	14.2	70.4	.51	58	1.50	2	924	65q	85	781
Willet, M2855	13099	58.5	36	14.8	14.1	69.5	.42	60	1.25	2	923	95	100	786
Selkirk, CT 186	13100	55.2	33	14.2	13.8	73.3	.52	62	2.00	2	881	90	100	766
Lee x Mida sib., Ns. 3880.127	13152	58.6	30	14.6	13.7	70.3	.51	61	2.25	2	886	100	95	775
Do. Ns. 3880.191	13153	59.0	27	14.4	13.5	68.2	.47	62	1.75	2	921	100	90	818
Frontana x II-44-29, II-50-17	13154	59.1	39	14.6	13.8	67.8	.49	61	1.50	2	953	100	100	829
Do. II-50-25	13155	59.1	40	15.3	13.9	69.0	.49	62	1.25	2	839	85	90	724
Do. II-50-34	13156	58.9	34	14.7	13.6	69.1	.44	62	1.75	2	937	80	85	827
R.L. 2563 x Lee, ND 1	13157	57.8	31	14.2	13.7	73.0	.57	62	2.25	2	899	85	90	787
Do. ND 2	13158	55.9	27	15.9	15.3	72.1	.65	62	2.00	2	964	80	95	756
Do. ND 3	13159	56.7	28	15.2	14.9	76.1	.66	63	2.25	2	872	85	95	702
Rushmore x Haynes Bluestem	13162	58.1	33	15.0	14.3	75.9	.53	62	1.50	2	913	90	95	766
Kenya-Gular-Pilot x K 58-Newthatch	13200	58.0	23	13.2	12.4	70.8	.65	64	2.00	2	769	85	80	744
Lee x Frontana, II-47-10		59.8	37	14.3	13.0	73.2	.52	61	1.75	2	851	90	90	786
Do. II-50-8		58.6	43	15.4	14.3	70.1	.54	59	1.50	2	858	70	90	720
Do. II-50-32		60.9	39	14.3	13.0	74.1	.47	57	1.75	2	820	95	90	757
Frontana x II-44-22, II-50-14		59.6	43	15.1	14.0	70.5	.55	59	1.25	2	821	80	85	704
Frontana x II-44-29, II-50-16		60.0	38	15.7	14.5	73.7	.53	59	1.25	2	854	95	90	707
Do. II-50-23		58.1	36	14.3	13.3	70.2	.53	59	1.50	2	846	80	85	763
Do. II-50-29		59.3	43	14.5	13.3	72.2	.53	57	1.25	2	841	95	90	759
Frontana x II-44-22, II-50-37		60.2	35	14.9	13.5	72.1	.62	57	1.75	2	849	90	90	755
Do. II-50-41		59.5	33	15.4	14.6	68.6	.53	57	2.00	1	879	100	95	722
Do. II-50-53		60.6	37	14.4	13.3	71.4	.50	57	2.00	1	850	95	95	767
Frontana x II-44-29, II-50-65		60.9	34	15.7	14.1	68.0	.47	57	1.75	2	872	105	90	742
Do. II-50-69		58.7	41	15.0	13.7	71.6	.45	57	2.00	2	901	85	90	789
Frontana x II-44-29, II-50-72		59.6	40	14.4	13.5	71.4	.46	57	2.25	2	937	90	95	833
Do. II-50-75		60.5	39	14.3	13.2	71.8	.46	57	1.75	2	884	90	90	803
Kentana x Yaqui, III-53-5		53.4	38	14.2	12.9	73.1	.51	57	1.50	2	959	85	85	892
Spinkcota	12375	58.1	39	14.3	13.3	71.5	.45	57	2.00	2	846	70	85	763
Yaqui-Egyptian-Timstein, III-54-8		57.8	53	15.5	14.2	72.1	.49	57	2.25	2	911	85	90	770
Average		57.5	34	14.5	13.6	71.6		59	1.78	1.8	876	87	91	773

1/ Composite of Morris, Crookston, St. Paul, and Waseca Stations.

Table 5. Continued 1/

Variety or Cross	C.I. No.	Test Weight	Pearling Index Value	Protein		Flour		Absorption	Mixing Time	Optimum Baking Method				Loaf Volume Corrected to 12.0 Percent Protein
				Wheat	Flour	Yield	Ash			Bromate	Loaf Volume	Crumb Color	Crumb Grain	
		Lb.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Min.	Mg.	Cc.	Score	Score	Cc.
Pilot[2] x Thatcher, N 2170	12974	56.2	27.7	16.4	14.7	73.7	.43	60	2.00	1	913	95	95	746
Lee x 1831, B52-119		57.0	31.0	15.2	13.9	73.9	.43	60	2.00	1	816	80	95	704
Rescue	12435	56.6	33.1	16.4	15.5	71.4	.43	60	2.25	2	903	75	90	699
Lee	12488	57.0	34.5	16.7	15.3	71.8	.42	60	2.00	2	815	85	95	639q
Lee x 1831, B52-63		59.5	34.7	16.0	14.5	71.3	.39	60	2.00	0	813	100	100	673q
1953 x Lee, B52-94		56.7	34.1	15.7	14.4	72.7	.39	60	2.25	1	853	80	95	710
Marquis	3641	57.4	28.9	16.5	15.0	69.3	.42	60	2.25	1	878	80	90	702
1764 x Rescue, B49-78		57.7	27.5	16.2	15.1	73.0	.43	60	2.25	2	906	90	85	720
Rescue x Regent, 4337-35		57.0	33.6	16.3	14.9	70.7	.42	60	1.75	2	850	70	85	684q
Supreme	8026	53.9	27.9	15.5	14.3	68.5	.42	60	2.50	2	860	75	85	722
1898 x Lee, B52-57		56.5	27.2	17.2	15.7	73.1	.44	60	2.25	1	916	95	100	700
Chinook, H-4258		59.3	33.8	16.1	15.2	71.7	.38	60	2.00	2	856	85	90	676q
Lee x 1831, B52-120		58.1	31.5	15.5	14.1	73.3	.39	60	1.75	2	840	85	85	715
1953 x Lee, B52-92		56.0	36.7	15.2	14.1	73.9	.38	60	2.00	3	870	85	85	740
1520 x 1752, N2389	13041	59.5	29.8	15.5	14.1	72.5	.39	60	1.75	2	831	80	90	707
Pilot[2] x Merit 2/, N2164		55.0	22.8	16.3	15.1	70.3	.46	62	2.25	1	887	90	90	705
Ceres	6900	57.6	25.4	16.0	14.8	72.5	.43	60	2.00	2	855	75	90	693
Rescue x Thatcher, B50-18		60.2	34.4	15.8	14.7	72.7	.40	60	1.75	1	861	90	95	703
Willet	13099	54.3	38.2	17.9	16.5	69.4	.42	62	1.00	2	810	75	80	589u
Selkirk	13100	53.5	32.1	15.6	14.8	71.1	.40	62	2.00	3	900	75	85	729
Marquis, Lohr		57.0	31.3	16.2	15.0	69.1	.41	60	2.00	3	899	80	90	719
Rescue x 1831, B51-9		57.2	32.3	16.7	15.6	72.6	.39	60	2.00	2	934	80	90	718
Rescue x Th.-S-615, B51-43		58.0	32.9	15.0	14.9	70.6	.38	60	2.00	2	815	85	90	656q
1953 x Lee, B52-91		57.4	34.4	14.9	13.7	71.9	.36	60	2.00	2	823	90	90	721
Thatcher	10003	55.3	31.6	16.6	15.3	69.5	.38	60	2.00	2	911	75	85	714
2236 x Lee, B52-107		55.7	34.4	15.9	14.3	72.5	.41	62	2.00	3	891	80	85	748
Pilot	11945	54.3	29.0	16.3	15.1	68.7	.36	60	2.25	1	929	80	85	738
Pilot[2] x Regent, N2183	13042	54.6	31.8	16.2	15.1	69.6	.38	60	2.50	2	956	80	85	760
Rescue x Th.-S-615, B51-27		57.6	36.6	16.4	15.4	68.8	.37	60	1.50	3	987	75	85	769
1953 x Lee, B52-90		59.0	33.6	16.7	15.2	71.8	.41	61	1.75	3	866	80	85	684
Rescue x Th.-S-615, B51-16		59.2	32.1	16.3	15.3	70.2	.45	62	2.00	2	861	80	85	675q
1750 x 1753, N2256	12975	57.3	29.0	15.6	14.3	71.4	.44	61	2.00	2	824	90	85	691
Average		56.9	31.7	16.1	14.9	71.4	.41	60	2.00	1.9	873	83	89	703

1/ Composite of Sidney, Havre and Moccasin Stations.

2/ Composite of Moccasin and Havre Stations.

Montana Advanced Yield Nursery

These wheats have made generally satisfactory bread with the differences in quality not very great between many of the samples. All have produced bread that was satisfactory in grain, with some better than others. The milling and dough-handling properties have been deficient in some. The crumb color scores were about medium with a few wheats making bread having scores of 85 or higher which is considered good. A few of the wheats have made bread lower in loaf volume than expected considering the protein content of the flour. These were weaker wheats than those samples producing loaf volumes more in accordance with that expected as based on their protein contents.

Lee x 1831 (B52-63) has perhaps produced the best bread of the group. It was slightly lower in loaf volume according to the protein content of the flour, but this is not too important considering its other properties. The variety Lee has generally produced a lower than expected loaf volume for its protein content. It is not surprising that this strain having one parent as Lee is somewhat similar to Lee in this respect. Strain 1898 x Lee (B52-57) was next best. It was one of the highest strains in protein content. Others making very good bread were Pilot^2 x Thatcher (N2170), Rescue x Thatcher (B50-18), Pilot^2 x Merit (N2164), and 1953 x Lee (B52-91). All these first six wheats were satisfactory in milling, produced a high yield of flour and the dough properties were strong, elastic, and pliable. These are very promising considering their milling and baking quality.

The strains ranking next best were Lee x 1831 (B52-119) Rescue, and Lee. These were slightly lower in crumb color, but otherwise made bread having grain nearly equal to those ranking in the first six places. These three milled satisfactorily, the dough properties were strong and grain of the bread good.

As a group the rest of the samples have made, with a few exceptions, generally good and very similar bread. The internal bread characteristics were perhaps not quite as good as the nine wheats already enumerated above. Chinook, Ceres, Thatcher, 1520 x 1752 (N2389), 1953 x Lee (B52-94), 1750 x 1753 (N2256), 1764 x Rescue (B49-78), Rescue x 1831 (B51-9), and 2235 x Lee (B52-107) milled good and their loaf volumes were normal for the protein content of the samples. The dough handling properties were strong and elastic. Strain 1953 x Lee (B52-94) was perhaps the best of these. Strains 1953 x Lee (B52-90), and Rescue x Thatcher-S-615 (B51-16 and 43) made equally good bread as those already mentioned in this group, but were slightly lower in loaf volume than expected considering the protein content of the samples. Marquis (Lohr), Marquis, Pilot, and Pilot^2 x Regent (N2183) appeared to be satisfactory for bread except that their milling properties were somewhat questionable. The bran of these wheats was thicker than normal and this with their generally low test weight perhaps accounts for the general low flour yields. Another year's samples might not show these characteristics. The two Marquis samples produced good bread and were very similar. The Lohr Marquis required a higher amount of potassium bromate (an oxidizing agent) for optimum bread results than the regular Marquis.

Those next best were Selkirk, 1953 x Lee (B52-92) and Lee x 1831 (B52-120). All made good bread that was generally similar except possibly for Selkirk that was slightly down on crumb color. The two strains had slightly sticky dough properties. All three samples milled satisfactorily. Selkirk would have ranked much higher had the crumb color been better.

Lee x 1831 (B52-120), Supreme, Rescue x Regent (4337-35), and Rescue x Thatcher-S-615 (B51-27) made bread of good loaf volumes and grain, but the crumb color was low. The crumb color scores are considered about the minimum of acceptability as based on the commercially approved varieties.

Willet ranked lowest in quality of the nursery samples. It had a very short dough-mixing time and was deficient in loaf volume, milling, and dough properties.

Sawfly Resistant Trials

The results for a number of varieties and strains resistant to wheat stem sawfly grown in nursery trials at Dutton, Froid, and Moccasin, Montana are shown in table 6. These trials include many strains of current interest. One of the principal interests in these tests is a comparison of the quality of the strains which include Rescue in their parentage with that of Thatcher and Rescue.

The small differences in quality between the samples have made it extremely difficult to rank the wheats. Most all have produced bread that was satisfactory in grain with some better than others. The milling and dough properties have been deficient in some. The crumb color scores were about medium with a few wheats making bread having crumb color scores of 85 or higher which is considered good.

It has been possible because of the general similarity in quality of a number of the samples to group them for the purposes of discussion.

The samples making the best bread and perhaps strongest of the wheats in this group were Rescue x Thatcher (B50-18), Chinook, Rescue x Thatcher-S-615 (B51-43 and B51-16), Rescue x Redman (4337-92), and 1764 x Rescue (B49-78). All milled well, the dough-handling properties were strong and the characteristics of the bread satisfactory. Rescue and Rescue x Thatcher-S-615 (B51-16) were perhaps slightly the best in this grouping. These wheats are slightly better than Thatcher and equal to Rescue.

Those next best were slightly lower in bread properties than the first group. These were Rescue x Saunders (4015-1E2 and 4015-8), Rescue x Regent (4016-2E L.501 and 4337-35), Rescue x Redman (4337-15), Rescue x Mida (4336-125), and Thatcher. These samples were generally similar in other respects to those ranked first. Rescue x Saunders (4015-1E2) made bread having excellent grain but the crumb color was low, the principal reason for its lower ranking. All samples in this group produced loaf volumes that were about that expected considering the protein content of the samples. Rescue x Regent (4337-35) produced a high yield of flour and was one of the more promising strains in this respect. These were generally slightly lower than Rescue in quality.

Those strains next best and making good bread but lacking some of the properties of Thatcher or Rescue were Mida x Rescue (Dick. 93), Rescue x 1831 (B51-9), Rescue x Regent (4337-24 and 4016-2E L.506), Rescue x Mida (4336-37), and Rescue x Saunders (4015-2). These were lower in crumb color (70 to 75) than the other two groups. These strains produced satisfactory loaf volumes for their protein contents, milled satisfactorily, and the dough-handling properties were strong and elastic. Rescue x Saunders (4015-2) was perhaps the poorest in this group, but still is a wheat of good strength and acceptable bread quality.

Rescue x Thatcher-S-615 (B51-27) and Mida x Rescue (Dick. 89) made good bread, but showed poor dough-handling properties. They both appeared to be satisfactory in quality other than for dough properties.

Strain 1764 x Rescue (B49-90) was ranked next to lowest because of questionable milling properties. The middlings reduced to flour with difficulty.

Rescue x Mida (4336-72) was poorest of the samples in this composite. The internal bread characteristics were about the minimum for acceptability. Otherwise the strain seemed satisfactory.

Table 6. Milling, baking, and chemical results on hard red spring wheats grown in the Uniform Sawfly Yield Nursery, 1954 crop 1/

Variety or Cross	C. I. No.	Test Weight	Pearling Index Value	Protein		Flour		Absorption	Mixing Time	Optimum Baking Method				Loaf Volume Corrected to 12.0 Percent Protein
				Wheat	Flour	Yield	Ash			Bromate	Loaf Volume	Crumb Color	Crumb Grain	
		Lb.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Min.	Mg.	Cc.	Score	Score	Cc.
Rescue x Thatcher, B50-18		59.8	39	13.6	12.6	75.5	.38	60	2.00	2	782	85	85	744
Mida x Rescue, Dick. 93		59.0	36	14.1	13.2	74.1	.37	59	1.50	2	815	75	85	740
1764 x Rescue, B49-90		57.8	29	14.5	13.5	69.7	.42	60	1.75	3	804	75	85	715
Rescue x Saunders, 4015-1E2		57.1	40	14.2	13.2	72.3	.38	59	1.50	1	800	75	95	728
Rescue x 1831, B51-9		58.2	37	14.3	13.6	73.3	.37	59	1.50	2	877	75	80	773
Rescue x Th.-S-615, B51-27		58.1	41	14.2	13.2	71.4	.43	59	1.75	2	804	85	90	730
Rescue x Regent, 4016-2E (L.501)		57.5	39	14.2	13.3	73.5	.41	59	2.00	1	833	80	85	752
Rescue x Redman, 4337-15		57.5	39	14.7	13.7	73.4	.41	59	2.00	2	864	80	85	757
Rescue x Mida, 4336-125		58.0	38	14.1	13.1	72.6	.38	59	1.75	2	807	80	80	739
Rescue	12435	58.0	37	14.0	13.1	73.9	.40	59	2.00	1	847	90	90	776
Rescue x Regent, 4337-24		58.0	39	14.0	13.1	72.7	.39	59	1.75	2	815	75	90	746
Rescue x Regent, 4337-35		58.0	39	14.1	12.9	74.9	.38	59	2.00	2	854	80	85	794
Mida x Rescue, Dick. 89		59.5	41	14.3	13.1	74.4	.37	59	1.50	2	806	85	90	738
Chinook, H-4258		58.5	36	14.4	13.4	72.3	.38	59	2.00	2	803	85	85	718
Rescue x Saunders, 4015-8		57.5	39	14.6	13.4	72.2	.39	59	2.00	2	856	85	80	767
Rescue x Regent, 4016-2E (L.506)		58.0	39	14.3	13.1	73.3	.38	59	2.00	2	842	75	85	771
Rescue x Th.-S-615, B51-43		58.4	35	14.5	13.6	71.0	.39	59	2.00	2	816	85	85	720
Rescue x Redman, 4337-92		57.1	39	14.0	12.9	74.2	.40	59	2.00	2	826	85	85	768
Rescue x Mida, 4336-37		58.0	38	14.1	12.9	73.0	.38	59	2.00	2	847	75	85	788
Rescue x Th.-S-615, B51-16		58.3	33	14.3	13.4	70.5	.42	59	1.75	1	782	80	90	701
Thatcher	10003	55.6	33	14.8	13.7	71.8	.40	59	2.00	2	858	80	85	751
Rescue x Mida, 4336-72		57.2	39	14.0	12.9	73.6	.37	59	2.00	1	844	65q	75	785
1764 x Rescue, B49-78		58.6	32	14.2	13.0	72.7	.38	59	2.00	1	839	85	85	775
Rescue x Saunders, 4015-2		57.0	39	14.8	13.6	71.9	.38	57	2.00	2	852	70	85	752
Average		57.9	37	14.3	13.2	72.9	.39	59	1.86	1.8	828	80	85	752

1/ Composite of Dutton, Froid, and Moccasin Stations.

Mexican Varieties and Strains in Nursery Trials

Twenty-five of the better varieties and strains from the Mexican breeding program with Lee, Selkirk, and Willet as checks were milled and bread baked from them. These were grown at Madison, Wisconsin; St. Paul, Crookston, and Morris, Minnesota; and Langdon and Fargo, North Dakota. The results for the six station composite are shown in table 7.

As a group, these varieties and strains were medium to high in protein and perhaps lower in test weight per bushel than usual for spring wheats. A number of the wheats milled poorly, which is rather unfortunate considering the generally good bread-baking quality of these wheats, as a whole. They required medium to high amounts of potassium bromate (an oxidizing agent) for optimum bread results. The flour yields were about normal for the test weight of the samples, except in a few cases where the yields were considerably higher than expected. These wheats were generally not as hard or vitreous as the hard red spring wheats which generally produce a granular flour in comparison to the soft and fluffy flour milled from soft wheat. A number of the Mexican wheats had pearling index values of 40 or higher and produced exceptionally soft flours to the feel or touch.

The best strains for bread, considering the data as a whole, were Kenya-Mentana x Cinco, Chapingo 52 and 53, Bajio 53, Yaqui 50, Yaqui x Mentana (2254-2c), Mexe 53, Lee, and Selkirk. They milled satisfactorily, producing a good yield of flour, and their dough handling properties were strong, pliable, and elastic.

Those wheats that were next best in quality and nearly as good as the varieties and strains enumerated above were Toluca 53, Yaqui 53, and Willet. These wheats were principally deficient in milling quality. Willet made surprisingly good bread in these trials, but because of the poor showing in past tests is considered an unsatisfactory bread wheat and will not be approved for release.

As already mentioned most of these wheats made good bread except that a number of them were deficient in dough handling and/or milling properties. Cajeme 54 was deficient in both properties while, Yaqui x Mentana Reo Negro, Lerma 50, Mayo 54, A-K x M S1088, and Toluca 54 were rated fair in dough properties and poor in milling. The Gabo samples 54A and 54 had fair dough and milling properties, made generally acceptable bread except for the loaf volumes of Gabo 54 which was somewhat lower than expected when corrected to a 12.0 percent flour protein basis. The undesirable dough handling properties in these wheats were found weak, sticky, or lacked elasticity. In those samples where the milling quality was unsatisfactory, the middlings were generally difficult to reduce to flour and frequently bolted or sieved slowly. In some samples the bran was found difficult to free from flour. These undesirable milling properties, no doubt, reduced the yields of flour obtained from a number of wheats. Lee, Selkirk, Willet, Yaqui x Kentana (2254-2c), Yaqui 50, Bajio 53, Chapingo 52 and 53, and Kenya-Mentana x Cinco were some of the better wheats in milling and produced high flour yields.

Yaktana 53 produced a remarkably high loaf volume for such a low percent of protein. It would appear from this that the quality of the protein is exceptionally good in this variety. Yaqui 53, Yaqui x Kentana (2254-1c), Supremo 51, and Cajeme 54A made good bread, had satisfactory dough handling properties, but were unsatisfactory in milling.

It is possible that in another year many of these wheats may show better milling properties. For the most part those that were deficient in milling produced soft type flours to the touch and handled like soft wheats in the mill. It is believed that these wheats are softer than those desired by the milling trade accustomed to milling hard red spring wheats.

This was an interesting group of wheats with respect to the use and response of potassium bromate in the baking formula. The unbromated loaves generally were low in volume and the internal characteristics very poor. They were considerably improved in bread quality with bromate. It appears that this may possibly be a characteristic of most of these foreign strains and varieties. Many of the foreign wheats required much more bromate than the commercially grown hard red spring wheat varieties.

Table 7. Milling, baking and chemical results for the Mexican wheats grown in nursery trials, 1954 crop 1/

Variety or Cross	C.I. No.	Acre Yield	Test Weight	Pearling Index Value	Protein		Flour		Absorption	Mixing Time	Optimum Baking Method				Loaf Volume Corrected to 12.0 Percent Protein
					Wheat	Flour	Yield	Ash			Bromate	Loaf Volume	Crumb Color	Crumb Grain	
		Bu.	Lb.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Min.	Mg.	Cc.	Score	Score	Cc.
Kenya-Ment. x Cinco		26.7	53.0	38.0	15.4	13.7	74.7	.41	59	2.50	2	932	85	95	816
Yaqui, 53A		33.5	55.0	44.7	14.8	13.2	65.1	.44	55	2.00	2	860	90	100	782
Toluca, 53		26.2	56.1	28.1	16.0	14.4	67.7	.48	58	2.00	2	845	95	95	704
Chapingo, 53		23.3	53.9	25.6	14.2	12.9	70.0	.44	59	1.75	1	788	85	90	733
Cajeme, 54		28.5	56.3	43.9	15.3	13.4	67.8	.52	58	1.50	2	817	80	80	732
Chapingo, 52		31.0	56.0	36.4	14.7	13.1	70.4	.43	58	2.00	2	857	85	90	785
Yaqui x Kentana, 2254-1C		19.3	53.2	36.0	15.0	13.2	66.1	.48	56	1.75	2	804	85	95	731
Yaqui x Ment. Reo Negro		29.3	59.5	35.9	14.7	13.1	65.7	.41	56	1.50	3	881	95	85	807
Yaktana, 53		21.9	55.0	46.2	14.6	13.2	66.0	.47	59	1.75	2	1088	85	95	989
Bajio, 53		28.2	57.6	25.6	14.0	12.8	71.1	.46	62	1.75	1	888	90	100	833
Yaqui, 50		28.3	53.6	26.2	14.5	13.2	71.7	.46	62	2.00	1	931	90	95	846
Lerma, 50		30.6	54.5	43.3	13.9	12.6	66.5	.48	58	1.25	3	755	80	75	719
Mayo, 54		25.9	53.1	52.7	16.0	14.3	69.4	.51	56	1.50	3	916	85	90	769
Yaqui, 53		32.7	57.0	46.2	16.1	14.6	69.1	.49	58	2.00	3	978	90	95	804
Supremo, 51		23.2	55.2	33.2	14.2	12.4	64.1	.47	60	1.75	2	838	85	90	811
Yaqui x Kentana, 2254-2C		23.9	53.3	25.0	14.2	13.1	72.1	.49	60	1.50	2	887	80	90	813
A-K x MS 1088		19.2	54.0	51.8	15.0	13.2	68.3	.49	56	1.25	2	768	70	80	698
Toluca, 54		20.0	54.5	36.1	14.5	12.4	65.7	.49	55	1.75	1	740	90	85	716
Mexe, 53		29.1	57.2	49.7	13.7	11.8	69.2	.44	55	2.00	1	737	90	95	749
Cajeme, 54A		30.0	57.0	45.7	15.8	14.0	66.7	.51	57	2.00	3	945	95	90	810
Gabo, 54A		27.3	56.1	43.9	16.7	15.1	71.7	.58	59	1.50	3	881	85	85	700
Gabo, 54		26.1	57.2	45.4	16.7	15.3	70.2	.59	60	1.75	2	844	85	90	662q
Lee	12488	28.2	55.4	28.4	15.2	14.3	72.7	.49	59	2.25	2	931	95	100	781
Selkirk	13100	29.5	55.3	32.9	16.4	15.0	73.9	.50	60	2.00	2	959	90	100	767
Willet	13099	35.7	57.8	35.9	17.0	15.8	74.4	.45	58	1.50	2	892	85	100	677
Average			55.5	38.3	15.1	13.6	69.2	.48	58	1.78	2	870	87	91	768

1/ Composite of Langdon, Fargo, St. Paul, Crookston, Morris, and Madison Stations.

Commercial Samples

As in past years, a number of commercially grown wheat samples were obtained through the Grain Division, Agricultural Marketing Service, for comparison with the varieties and strains produced in experimental plots. Sixteen such samples, representing a number of grades and types, were obtained at Great Falls, Montana; Denver, Colorado; and Minneapolis and Duluth, Minnesota. The samples were composited by grade from 2,896 cars of wheat grading No. 3 or better. This is the sixteenth season such samples have been tested. The results are given in table 8.

These samples generally averaged lower in protein content than the varieties and strains grown in experimental plot and nursery trials. The Great Falls, Montana samples averaged highest in protein content and Duluth, Minnesota samples lowest. The milling characteristics were much alike for the commercial and experimental samples with the commercial samples possibly slightly higher in yield of flour. Otherwise, the baking and chemical results do not appear to be greatly different when compared with samples having approximately the same protein content.

Table 8. Milling, baking, and chemical results on 16 composite commercial samples of hard red spring wheat obtained at Minneapolis, Duluth, Great Falls, and Denver, representing the 1954 crop

Location Where Obtained	U.S. Grade	No. of Cars	Test Weight	Pearling Index Value	Protein		Flour		Absorption	Mixing Time	Optimum Baking Method				Loaf Volume Corrected to 12.0 Percent Protein
					Wheat	Flour	Yield	Ash			Bromate	Volume	Crumb Color	Crumb Grain	
			Lb.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Min.	Mg.	Cc.	Score	Score	Cc.
Minneapolis, Minnesota	1 HVY DNS	123	61.3	35	13.1	12.2	76.5	.53	60	1.75	1	772	85	85	759
Do.	1 DNS	97	59.1	34	13.2	12.5	74.2	.51	59	2.25	1	794	85	80	762
Do.	2 DNS	125	58.1	34	13.2	12.4	73.6	.51	59	2.00	1	794	80	85	768
Do.	3 DNS	176	56.0	32	13.2	12.6	72.7	.51	59	2.25	1	833	85	90	793
Average			58.6	34	13.2	12.4	74.3	.52	59	2.06	1	799	84	85	772
Duluth, Minnesota	1 HVY DNS	25	60.7	33	12.3	11.6	74.0	.41	61	2.25	1	813	90	90	841
Do.	1 DNS	94	59.0	32	12.9	11.8	71.9	.42	59	2.50	0	747	85	80	759
Do.	2 DNS	145	58.3	32	12.9	12.1	72.4	.43	61	2.50	0	788	85	85	781
Do.	3 DNS	445	56.7	30	13.6	12.6	72.2	.41	59	2.50	1	785	90	90	747
Do.	3 NS	35	56.3	32	12.6	11.6	71.3	.41	59	2.50	0	756	90	85	782
Average			58.2	32	12.9	11.9	72.4	.47	60	2.45	.4	778	88	86	784
Great Falls, Montana	1 HVY DNS	445	61.0	36	14.1	12.7	73.7	.41	59	2.25	1	770	90	85	727
Do.	1 DNS	595	59.5	36	14.6	13.4	74.0	.41	62	2.25	1	838	90	95	750
Do.	2 DNS	206	57.8	35	15.2	14.1	71.7	.41	61	2.50	1	863	85	95	734
Do.	2 DNS	170	60.0	34	14.5	13.5	72.8	.42	61	2.25	1	845	85	95	751
Do.	3 DNS	170	56.7	35	15.4	14.3	70.9	.47	59	2.25	1	897	90	95	752
Average			59.0	35	14.8	13.6	72.6	.42	60	2.30	1	843	88	93	744
Denver, Colorado	1 HVY DNS	30	61.0	30	14.2	13.5	72.9	.50	63	2.00	1	775	90	95	689
Do.	1 NS	15	60.1	37	14.0	13.4	77.3	.51	63	2.00	1	782	80	85	700
Average			60.5	34	14.1	13.5	75.1	.51	63	2.00	1	778	85	90	691
Total Cars		2896													

Strains and Varieties of Current Interest

Each year many new wheats are tested along with the leading commercial varieties for chemical composition, milling, and bread baking quality. The data on four hybrid strains with averages expressed as a percentage of comparable samples of Lee are shown in table 9. These selections were developed at and first included in trials in North Dakota.

R.L. 2563 x Lee, ND 2, C.I. 13158

The weighted average of three comparable samples shows that ND 2 has exceeded Lee in test weight per bushel, protein content of wheat and flour, and in bread loaf volume and grain. It averaged considerably higher in flour ash content than Lee. ND 2 milled satisfactorily but produced less flour than Lee on the basis of their test weights. The dough handling properties were strong, being pliable and elastic. This is a promising wheat.

R.L. 2563 x Lee, ND 1, C.I. 13157

Comparable milling and baking tests of five samples show that ND 1 has exceeded Lee in most of the characteristics for which comparisons have been made. It is about the same in flour ash content and has made better bread than Lee. It milled satisfactorily. This is perhaps the best of the three R.L. 2563 x Lee selections. It has made a good showing in past years' tests.

R.L. 2563 x Lee, ND 3, C.I. 13156

The average of three samples shows that ND 3 is similar to ND 2 in chemical, milling, and bread-baking properties. It exceeds Lee in a number of characteristics. ND 3 is a promising wheat and has produced good bread.

It is of interest that these three North Dakota selections have all exceeded the comparably grown Lee in protein content. The gluten characteristics have been strong and elastic, a promising property in a wheat intended for bread. These selections are equal to, if not superior, to some of the approved hard red spring wheats.

Lee x Mida sib., Ns. 3880.127, C.I. 13152

The weighted average of ten comparable samples shows that Ns. 3880.127 is very similar in milling and baking performance to Lee. It made acceptable bread and the dough-handling properties were elastic and strong. It milled satisfactorily and produced a good yield of flour in comparison to the test weight per bushel of the grain. It is a promising bread selection.

Table 9. Comparison of the test weight per bushel, milling, baking, and chemical properties of four strains of wheat with the variety Lee, 1954 crop

Variety or Cross	No. of Samples	Test Weight	Pearling Index Value	Protein		Flour		Absorption	Mixing Time	Optimum Baking Method			
				Wheat	Flour	Yield	Ash			Bromate	Loaf Volume	Crumb Color	Crumb Grain
		Lb.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Min.	Mg.	Cc.	Score	Score
RL 2563 x Lee, ND2	3	59.8	28	15.7	14.9	72.2	.58	62	2.25	1.3	888	82	93
Lee	3	56.6	30	14.1	13.2	73.2	.49	62	2.33	1.3	823	90	87
Percentage of Lee		105.6	93.3	111.3	112.8	98.6	118.3	100.0	96.5	100.0	107.8	91.1	106.8
RL 2563 x Lee, ND1	5	57.6	30	14.7	14.0	73.7	49	61	2.25	1.2	855	90	92
Lee	5	55.7	28	14.0	13.2	73.0	50	61	2.30	1.4	811	87	88
Percentage of Lee		103.4	107.1	105.0	106.0	100.9	98.0	100.0	97.8	85.7	105.4	103.4	104.5
RL 2563 x Lee, ND3	3	58.1	28	15.4	14.6	74.3	60	63	2.25	1.7	849	88	93
Lee	3	56.6	30	14.1	13.2	73.2	49	62	2.33	1.3	823	90	87
Percentage of Lee		102.6	93.3	109.2	110.6	101.5	122.4	101.6	96.5	130.8	103.1	97.7	106.8
Lee x Mida sib., Ns. 3880.127	10	57.1	26	15.0	13.9	72.1	46	60	1.73	2.2	800	88	87
Lee	10	55.4	27	14.5	13.5	71.9	46	60	2.25	1.4	806	86	89
Percentage of Lee		103.7	96.0	103.4	103.0	100.3	100.0	100.0	76.9	157.1	99.3	102.3	97.8